

MEANDER LINE SLOT ANTENNA DESIGN FOR WLAN APPLICATION

PUTERI NUR RAIHAN BINTI NAJMULDIN

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For my beloved mother, father, family and friends.

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## ABSTRACT

In wireless communication, miniaturized antennas are becoming the necessary task to achieve an optimal design so that the entire transceivers can be on a single chip thus reducing the cost. Study shows that as size decreases, the bandwidth and efficiency will also decrease. These are the fundamental limitation that becomes the major factor in antenna architecture. The objective of the project is to design, simulate and fabricate a meander line slot antenna for WLAN application at frequency 2.4 GHz. Computer Simulation Technology (CST) software is used in simulation process to simulate the return loss, gain and radiation pattern. The design is fabricated on double layer FR4 board using chemical etching technique. Then the design has been tested with Advantest Network Analyzer and Spectrum Analyzer to measure return loss, gain and radiation pattern. The simulation results show the antenna has good return loss with bandwidth 150.6 MHz and gain 4.414 dB. The measurement result shows that the return loss is similar to simulation result. The gain of fabricated antenna is higher compared to simulation gain. The measured radiation pattern is similar with simulated radiation pattern. The half power beamwidth (HPBW) for simulation is  $80.9^\circ$  higher than measurement HPBW which is  $73.7^\circ$ .

## ABSTRAK

Dalam komunikasi tanpa wayar, antenna bersaiz kecil menjadi tugas yang perlu dilakukan untuk mencapai rekaan yang optimum supaya semua penghantar terima boleh berada diatas satu cip tunggal lalu mengurangkan kos. Kajian menyatakan bahawa apabila saiz berkurangan, jalur lebar dan kecekapan juga akan berkurangan. Ini adalah had asas yang menjadi faktor utama Objektif projek ini ialah untuk mereka, simulasi dan mengukur antenna meander line slot untuk aplikasi WLAN pada frekuensi 2.4 GHz. Perisian Computer Simulation Technology (CST) digunakan untuk proses simulasi rekaan. untuk simulasi pertambahan, susut balik dan corak radiasi antenna. Rekaan antenna difabrikasi di atas papan dua lapis Flame Retardant 4, (FR4) dengan menggunakan teknik ukiran kimia. Rekaan kemudiannya diuji dengan menggunakan Advantest Network Analyzer dan Spectrum Analyzer untuk pengukuran pertambahan, susut balik dan corak radiasi Keputusan simulasi menunjukkan antenna mempunyai nilai susut balik yang baik dengan nilai jalur lebar 150.6 MHz dan kenaikan 4.414 dB. Corak radiasi yang diukur mempunyai bentuk yang hampir sama dengan simulasi. Nilai Half Power Beamwidth (HPBW) untuk simulasi adalah  $80.9^\circ$  lebih tinggi daripada nilai ukuran HPBW iaitu  $73.7^\circ$ .



**TABLE OF CONTENTS**

<b>CHAPTER</b>	<b>TITLE</b>	<b>PAGE</b>
	<b>PROJECT TITLE</b>	
<b>i</b>		
	<b>DECLARATION</b>	
<b>ii</b>		
	<b>DEDICATION</b>	
<b>iii</b>		
	<b>ACKNOWLEDGEMENT</b>	
<b>iv</b>		
	<b>ABSTRACT</b>	
<b>v</b>		
	<b>ABSTRAK</b>	
<b>vi</b>		
	<b>TABLE OF CONTENTS</b>	
<b>vii</b>		
	<b>LIST OF TABLES</b>	
<b>viii</b>		
	<b>LIST OF FIGURES</b>	
<b>ix</b>		
<b>I</b>	<b>INTRODUCTION</b>	

1	1.1	Project Background
3	1.2	Objective of the Project
3	1.3	Problem Statement
4	1.4	Scope of Project

## **II LITERATURE REVIEW**

5	2.1	Introduction to Antenna
9	2.1.1	Radiation Pattern
10	2.1.2	Gain
11	2.1.3	Bandwidth
12	2.1.4	Directivity
13	2.1.6	Half-power Beamwidth and First Null Beamwidth
14	2.1.7	Polarization
16	2.2	Microstrip Feedline

16	2.2.1	Microstrip Line Feed
17	2.3	Microstrip Antennas
19	2.4	Slotline Antennas
21	2.5	Meander Line Antenna
21	2.5.1	Dual Band Meander Line Antenna
23	2.5.2	Tapered Meander Line Antenna
24	2.5.3	Sleeve Meander Line Antenna
25	2.5.4	Planar Meander Line Antenna
27	2.5.5	Cavity Backed Slot Antenna
28	2.5.6	Compact Meander Line Slot Antenna

### **III MICROSTRIP MEANDER LINE SLOT ANTENNA DESIGN**

29	3.1	Design Process
32	3.2	Initial Antenna Design

34	3.3	Parameter Analysis
34	3.3.1	The Analysis on Number of Turns, $N$
34	3.3.2	The Analysis on Dumbbell Size
		35
	3.3.3	The Analysis on Meander Width
		35
	3.3.4	The Analysis on Vertical and
		36
		Horizontal Slot Length ( $b$ and $a$ )
	3.3.5	The Analysis on Vertical Length, ( $b$ )
		36
	3.3.6	The Analysis on Horizontal Length, ( $a$ )
		37
	3.3.7	The Analysis on Dumbbell Size
		37
		with Meander Width 7.5 mm
	3.3.8	The Analysis of Dumbbell Size
		38
		with Meander Width 7.6 mm
	3.3.9	The Analysis of Horizontal Width
		39

	3.3.10	The Analysis of Vertical Width	40
	3.3.11	The Analysis on Design II Dumbbell Radius	41
	3.3.12	The Analysis on Design III Dumbbell Radius	43
44	3.4	Simulation Process	
46	3.5	Fabrication Process	
47	3.6	Measurement Process	
47	3.6.1	Return Loss Measurement	
49	3.6.2	Radiation Pattern Measurement	
50	3.6.3	Gain Measurement	
<b>IV</b>		<b>RESULTS, ANALYSIS AND DISCUSSIONS</b>	
51	4.1	Simulation Results	
52	4.1.1	The Analysis on Number of Turns, $N$	
	4.1.2	The Analysis on Dumbbell Size	53

4.1.3	The Analysis on Meander Width	54
4.1.4	The Analysis on Vertical and Horizontal Slot Length ( $b$ and $a$ )	55
4.1.5	The Analysis on Vertical Length, ( $b$ )	56
4.1.6	The Analysis on Horizontal Length, ( $a$ )	57
4.1.7	The Analysis on Dumbbell Size with Meander Width 7.5 mm	58
4.1.8	The Analysis of Dumbbell Size with Meander Width 7.6 mm	59
4.1.9	The Analysis of Horizontal Width	60
4.1.10	The Analysis of Vertical Width	61
4.1.11	The Analysis on Design II Dumbbell Radius	61
4.1.12	The Analysis on Design III Dumbbell Radius	63
4.2	Optimum Antenna Design	66

	4.2.1	Design I	66
	4.2.2	Design II	68
	4.2.3	Design III	70
	4.3	Simulation Results	72
	4.4	Measurement Results	74
<b>V</b>		<b>CONCLUSIONS AND RECOMMENDATIONS</b>	<b>76</b>
		<b>REFERENCES</b>	<b>77</b>

## LIST OF TABLES

<b>NO</b>	<b>TITLE</b>	<b>PAGE</b>
3.1	Initial Parameter of Meander Line Slot Antenna	32
3.2	Dumbbell Size Parameter Analysis with Meander Width 7.5mm	37
3.3	Dumbbell Size Parameter Analysis with Meander Width 7.6mm	38
3.4	Horizontal Width Parameter Analysis	39
3.5	Vertical Width Parameter Analysis	40
3.6	Design II Antenna Parameter	42
3.7	Design III Antenna Parameter	44
4.1	N Parameter Analysis	52
4.2	Dumbbell Size Parameter Analysis	53
4.3	Meander Width Parameter Analysis	54
4.4	Vertical Length and Horizontal length (a and b) Parameter Analysis	55
4.5	Vertical Length ( <b>b</b> ) Parameter Analysis	56
4.6	Horizontal Length Parameter Analysis	57



		17
4.7	Dumbbell Size Meander Width 7.5 mm Parameter Analysis	58
4.8	Dumbbell Size Meander Width 7.6 mm Parameter Analysis	60
4.9	Horizontal Width Parameter Analysis	61
4.10	Vertical Width Parameter Analysis	62
4.11	Design II Dumbbell Radius Parameter Analysis	63
4.12	Design III Dumbbell Radius Parameter Analysis	65
4.13	Dimension and Parameter of Design I	66
4.14	Dimension and Parameter of Design II	68
4.15	Dimension and Parameter of Design III	70
4. 16	Summarized Simulation Meander Line Slot Designs	72
4.17	Measurement Results	74

## LIST OF FIGURES

<b>NO</b>	<b>TITLE</b>	<b>PAGE</b>
2.1	Wire antennas	6
2.2	Aperture antennas	7
2.3	Reflector antennas	7
2.4	Lens antennas	8
2.5	Array antennas	8
2.6	Radiation Pattern Lobes and Beamwidths of Antenna Pattern	9
2.7	Linear Plots of Power Pattern and Associated Lobes and Beamwidth	10
2.8	Bandwidth of Antenna	13
2.9	Half-Power Beamwidth and First Null Beamwidth	15
2.10	Types of Polarization	15
2.12	Rotation of Wave	15
2.13	Polarization Ellipse	16
2.14	Rectangular Microstrip Patch Antenna	18
2.15	Circular Microstrip Patch antenna	19
2.16	Cavity Backed Slot Antenna	20

		19
2.17	Annular Slot Antenna	20
2.18	Meander antenna prototype with the shaped ground plane and back coupled rectangular patch	22
2.19	Meander line antenna with hat-shaped ground plane and back coupled rectangular patch	22
2.20	Tapered Meander Line Antenna with Dual Sleeve on A Small Ground	23
2.21	Tapered Slot Antenna	24
2.22	Meander line sleeve antenna	25
2.23	Planar Dual Meander Line Antenna	26
2.24	Helical Meander Line Antenna	27
2.25	Cavity Backed Slot Antenna	28
2.26	Microstrip-fed slot antenna structure	30
2.27	Microstrip Line Feed	30
3.1	Design Process	31
3.2	Front View of Feedline Design	31
3.3	Three Dimension View of Feedline Design	32
3.4	Wiremode Frame of Feedline Design	33
3.5	Initial Structure MLSA (Design I)	33
3.6	Parameter of Design I	33
3.7	Wiremode Frame of Design I	34
3.8	(a) Side view Design I (b) Perspective View Design I	35
3.9	Number of Turns, $N$ from 2 to 5	35
3.10	Dumbbell Size Parameter Analysis	36

		20
3.12	Vertical and Horizontal Slot Length Parameter Analysis	36
3.13	Vertical Length Parameter Analysis	37
3.14	Horizontal Length Parameter Analysis	38
3.15	Dumbbell Size with Meander Width of 7.5 mm Parameter Analysis	39
3.16	Dumbbell Size with Meander Width of 7.6 mm Parameter Analysis	40
3.17	Horizontal Width Parameter Analysis	41
3.18	Vertical Width Parameter Analysis	41
3.19	Design II	41
3.20	Three Dimensional View of Design II	42
3.21	(a) Side View Design II (b) Perspective View Design II	42
3.22	Design II Dumbbell Radius	43
3.23	Design III	43
3.24	Three Dimensional View of Design III	43
3.25	(a) Side View Design III (b) Perspective View Design III	44
3.26	Design III Dumbbell Radius	46
3.27	Fabrication Process	47
3.28	(a) Design I, (b) Design II (c) Design III	48
3.29	Advantest Network Analyzer	48
3.40	Short, Load and Open connector	49
3.41	Return Loss Measurement Setup	50
3.42	Radiation Pattern Measurement Setup	50
4.1	Return Loss Graph on Vertical Length, (b)	56

		21
4.2	Return Loss on Horizontal Length	57
4.3	Return Loss on Dumbbell Size with Meander Width 7.5 mm	59
4.4	Return Loss on Dumbbell Size with Meander Width 7.6 mm	60
4.5	Return Loss for Design II Dumbbell Radius	64
4.6	Parameter of Design I	66
4.7	Design I	67
4.8	Three Dimensional View of Design I	67
4.9	(a) Side view of Design I (b) Perspective View of Design II	67
4.10	Parameter of Design I	68
4.11	Design II	68
4.12	Three Dimensional View of Design II	69
4.13	(a) Side View of Design II (b) Perspective View of Design II	69
4.14	Parameter of Design III	70
4.15	Design III	70
4.16	Three Dimension View of Design III	71
4.17	(a) Side View of Design III (b) Perspective View of Design III	71
4.18	Return Loss for Design I, Design II and Design III	72
4.19	Simulated Radiation Pattern for <b>E</b> -Plane	73
4.20	Simulated Radiation Pattern for <b>H</b> -Plane	73
4.21	Measured and Simulated Radiation Pattern for Design	75
4.22	Measured and Simulated Radiation Pattern for Design II	75
4.23	Measured and Simulated Radiation Pattern for Design III	76

## LIST OF ABBREVIATIONS

<b>T<sub>x</sub></b>	-	Transmit Antenna
<b>R<sub>x</sub></b>	-	Receiver Antenna\
<b>WLAN</b>	-	Wireless Local Area Network
<b>LAN</b>	-	Local Area Network
<b>MLA</b>	-	Meander Line Antenna
<b>MLSA</b>	-	Meander Line Slot Antenna
<b>FR4</b>	—	Flame Resistance 4
<b>D</b>	-	Length of dumbbell
<b>V</b>	-	Width of dumbbell
<b>N</b>	-	Number of meander turns
<b>a</b>	-	Horizontal slot
<b>b</b>	-	Vertical Slot
<b>W<sub>a</sub></b>	-	Width of Horizontal slot
<b>W<sub>b</sub></b>	-	Width of Vertical slot
<b>CST</b>	-	Computer Simulation Technology
<b>BW</b>	-	Bandwidth
<b>U</b>	-	radiation intensity

$P_{in}$	-	total input power
$f_L$	-	highest frequency
$f_H$	-	lowest frequency
$D$	-	directive gain
$P$	-	power density at some point with a given antenna
$P_{ref}$	-	power density at the same point with reference antenna
$D$	-	directivity
$U_0$	-	radiation intensity of isotropic source
$P_{rad}$	-	power radiate
$P_R$	-	reflected power
$P_T$	-	transmitted power
HPBW	-	Half Power Beamwidth
FNBW	-	First Null Beamwidth
CW	-	clockwise
CCW	-	counter clockwise
FTD	-	Finite Time Domain
TD-TLM	-	three dimensional time-domain transmission line matrix
PCS	-	Personal Communication System
CDMA	-	code division multiple access
$e_1$	-	vertical printed traces
$e_2$	-	horizontal printed traces
$L_{ax}$	-	vertical length of antenna
PML	-	perfectly matched layers

$W_s$	-	width
$t_s$	-	thickness
$e_1$ and $e_2$	-	length of trace area
HFSS	-	High Frequency Structure Simulator
FEM	-	Finite Element Method
MOM	-	Method of Moment
$\Delta L$	-	inductive loading effect
$S$	-	vertical length
$L$	-	the length of meander line antenna
$W$	-	width of microstrip feed line
$A$	-	constant
$d$	-	thickness of substrate
$B$	-	constant
$\epsilon_r$	-	relative permittivity
$Z_o$	-	characteristic impedance
$\beta$	-	propagation constant
$\epsilon_e$	-	effective dielectric constant
$l$	-	length of microstrip feed line
$K_o$	-	cut off wavenumber
$d$	-	thickness
$h$	-	conductor thickness
<b>E-plane</b>	-	horizontal plane